USNO Analysis Center for Source Structure Report

Alan L. Fey, David A. Boboltz, Roopesh Ojha, Ralph A. Gaume, Kerry A. Kingham

Abstract

This report summarizes the activities of the United States Naval Observatory Analysis Center for Source Structure for calendar year 2006. VLBA RDV experiments RDV57 and RDV59 were calibrated and imaged. VLBA high frequency experiment BL122C was calibrated and imaged. Images from these three experiments, together with images from RDV16 and RDV23 were added to the USNO Radio Reference Frame Image Database. A Southern Hemisphere imaging and astrometry program for maintenance of the ICRF continued. Activities planned for the year 2007 include continued imaging of ICRF sources at standard and higher frequencies and continued analysis of source structure and its variation.

1. Analysis Center Operation

The Analysis Center for Source Structure is supported and operated by the United States Naval Observatory (USNO). The charter of the Analysis Center is to provide products directly related to the IVS determination of the "definition and maintenance of the celestial reference frame." These include, primarily, radio frequency images of ICRF sources, intrinsic structure models derived from the radio images, and an assessment of the astrometric quality of the ICRF sources based on their intrinsic structure.

The web server for the Analysis Center is hosted by the USNO and can be accessed by pointing your browser to

`http://rorf.usno.navy.mil/ivs_saac/`

The primary service of the analysis center is the Radio Reference Frame Image Database (RRFID), a web accessible database of radio frequency images of ICRF sources. The RRFID contains 4164 Very Long Baseline Array (VLBA) images (a 20% increase over the previous year) of 517 sources (a 4% increase over the previous year) at radio frequencies of 2.3 GHz and 8.4 GHz. Additionally, the RRFID contains 1154 images (a 18% increase over the previous year) of 270 sources (a 6% increase over the previous year) at frequencies of 24 GHz and 43 GHz. The RRFID can be accessed from the Analysis Center web page or directly at

`http://www.usno.navy.mil/rrfid.shtml`

A recent addition to the RRFID are 74 Australian Long Baseline Array (LBA) images of 69 southern hemisphere ICRF sources at a radio frequency of 8.4 GHz.

Shown in Figure 1 is the distribution on the sky of the sources which have been imaged at 2.3 GHz and 8.4 GHz.

2. Current Activities

2.1. RDV Imaging

VLBA experiment RDV59 (2006SEP13) was calibrated and imaged, adding 184 (92 S-band; 92 X-band) images to the RRFID including images of 7 sources (0220-349, 1244-255, 1308+328, 1640-231, 1758+388, 1805-214 and 2005-489) not previously imaged.

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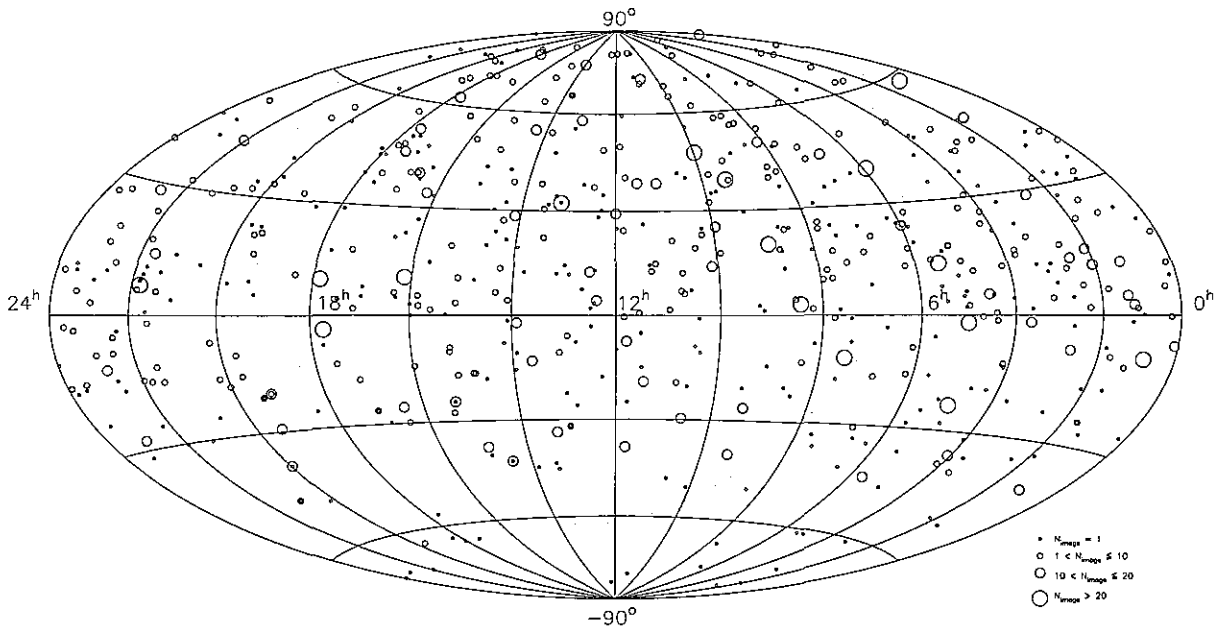

Figure 1. Distribution of the sources which have been imaged at 2.3 GHz and 8.4 GHz shown on an Aitoff equal area projection of the celestial sphere. The size of the open circles indicates roughly the number of times each source has been imaged as indicated by the key.

VLBA experiment RDV57 (2006JUL11) was calibrated and imaged, adding 160 (80 S-band; 80 X-band) images to the RRFID including images of 4 sources (0151+474, 0629-418, 0834-201 and 1032-199) not previously imaged.

VLBA experiment RDV23 (2000OCT23) was calibrated and imaged, adding 188 (94 S-band; 94 X-band) images to the RRFID including images of 4 sources (0118-272, 0925-203, 1451-400 and 0836+182) not previously imaged. These results were contributed by Glenn Piner and Corey Nichols of Whitier College who calibrated, edited and imaged the data.

VLBA experiment RDV16 (1999JUN21) was calibrated and imaged, adding 182 (91 S-band; 91 X-band) images to the RRFID including images of 5 sources (0135-247, 0338-214, 0610+260, 1734+363 and 1806+456) not previously imaged. These results were contributed by Glenn Piner and Corey Nichols of Whitier College who calibrated, edited and imaged the data.

Collaborations continue with Glenn Piner at Whitier College and Patrick Charlot of Bordeaux Observatory to calibrate and image several of the RDV experiments.

2.2. VLBA High Frequency Imaging

VLBA observations to extend the ICRF to 24 and 43 GHz continued in 2006. These observations are part of a joint program between the National Aeronautics and Space Administration, the USNO, the National Radio Astronomy Observatory (NRAO) and Bordeaux Observatory. During the calender year 2006 one VLBA high frequency experiment, BL122C, was calibrated and imaged adding 178 (K-band only) images to the RRFID including images of 15 sources not previously imaged.

2.3. ICRF Maintenance in the Southern Hemisphere

The USNO and the Australia Telescope National Facility (ATNF) continue a collaborative program of VLBI research on Southern Hemisphere source imaging and astrometry using USNO, ATNF and ATNF-accessible facilities. These observations are aimed specifically toward improvement of the ICRF in the Southern Hemisphere by a) increasing the reference source density with additional bandwidth-synthesis astrometric VLBI observations, and b) VLBI imaging at 8.4 GHz of ICRF sources south of $\delta = -20°$.

3. Staff

The staff of the Analysis Center is drawn from individuals who work at the USNO. The staff are: Alan L. Fey, David A. Boboltz, Roopesh Ojha, Ralph A. Gaume and Kerry A. Kingham.

4. Future Activities

The Analysis Center currently has a program of active research investigating the effects of intrinsic source structure on astrometric position determination. Results of this program are published in the scientific literature.

The following activities for 2007 are planned:

- Continue imaging and analysis of VLBA 2.3/8.4/24/43 GHz experiments;
- Make additional astrometric and imaging observations in the Southern Hemisphere in collaboration with ATNF partners;
- Fey et al. (2004, AAS, 205, 9112) developed an algorithm to use images from the RRFID to classify sources in terms of their suitability for astrometric use based on their spatial compactness. Initially applied to the high frequency (24/43 GHz) data, the method will be applied to the study of ICRF sources at the standard frequencies (2.3/8.4 GHz).

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